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Spruce Budworm
in New Brunswick

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THE SPRUCE BUDWORM

In New Brunswick

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The spruce budworm is the most destructive insect in Canadian forests and between 1909 and 1946 periodic outbreaks have killed an estimated 250 million cords of balsam fir and spruce in Eastern Canada. The last outbreak in New Brunswick before the present one occurred between 1912 and 1920. At that time the insect attacked forests of the Province; fir trees were almost completely killed out over large areas and many of the spruce trees also died. Effects of this attack on the growth of surviving trees can still be seen. Annual rings for this period are narrower on older trees throughout the Province.

The present outbreak first became severe about 1949. It started in the large areas of mature pulpwood forest in the north where balsam fir is the predominant tree. The infestation has increased more or less steadily since that time and by 1957 covered practically all of the northern two-thirds of the Province. By 1951, studies had indicated that some of the stands infested would begin to die as a result of the 1952 attack, following previous injury, unless protected by spraying. A program of aerial spraying commenced in 1952 and has continued each year since that time. The policy has been to spray areas where accumulated defoliation and numbers of overwintering budworms make spraying necessary to prevent serious mortality from the next year's attack. Some of the older-infested areas have been sprayed two or more times, others only once; severe widespread mortality thus has been prevented up to now.

Possibilities for improving natural control by using parasites or disease is under study but we have not yet obtained positive results. So far, success with such methods, known as "biological control", has been with introduced rather than native pests. This leaflet will help to explain the nature of the problem and its relation to forest management. In particular, it applies to New Brunswick where the most severe outbreaks in the Atlantic Provinces have occurred.

Description of Insect and Habits

The spruce budworm is a caterpillar that feeds on the foliage of several softwood trees but chiefly on spruce and fir. It originates from an egg laid by a grayish brown moth about one-half inch long. The yellowish green eggs are laid in groups on the needles of the tree. The egg hatches in August and the minute caterpillar (larva) crawls into a crevice on the branches where it covers itself with a web (hibernaculum) and remains dormant over the winter. In the spring when the buds are swelling, it emerges and starts feeding by mining into the old needles, staminate flowers, or opening buds. As the new shoots grow it feeds on the developing foliage inside a thin web; it sometimes completely destroys the shoot. The larva prefers to feed on the new growth but, when it has destroyed it, will feed on old needles.

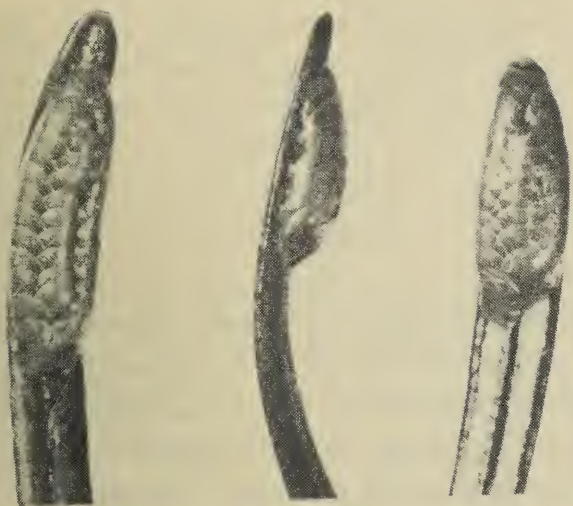


Fig. 1. The female moth lays masses of overlapping greenish eggs on the needles from which small caterpillars emerge to overwinter on the branches.



Fig. 2. The caterpillars feed on the buds and new foliage in the spring and when fully grown are brownish and about $\frac{3}{4}$ inch long.



Fig. 3. The caterpillar makes a thin web and turns into a brown pupa.



Fig. 4. The greyish-brown moth emerges from the pupa.

About the first week of July — depending on location and weather — the caterpillar reaches its full size and ceases feeding; at maturity, it is three-quarter inches long, brown with light and dark markings. At this stage, the larva turns into a brown pupa and after about ten days the moth emerges. Males and females occur in equal numbers and after mating the females lay their eggs. The next generation hatches to overwinter and continue the attack the following year.

The Damage

An attack does not affect the trees seriously unless the insect is numerous enough to destroy a substantial amount of the new growth. During outbreaks, however, the larvae may destroy most or all of the new foliage and sometimes all the buds and shoots. The trees will succeed in putting out new growth the following year and will recover unless the attack remains severe for about four years. Recovery depends on the vigor of the trees and the severity of the infestation. After four or more years of attack, many balsam fir trees may become almost completely defoliated and wood and shoot growth decline sharply; after this they may begin to die.

Spruce trees are more resistant to budworm attack and usually are killed only when mixed with balsam fir. White and red spruce, however, have been killed in considerable numbers during prolonged outbreaks. Black spruce is seldom killed, and is especially resistant when growing in pure stands.

In July and August, severely infested stands take on a reddish appearance caused by the dead, partly consumed new growth at the ends of the branches. This color gradually disappears and the trees resume a green or grayish appearance but with bare shoots or branch tips noticeable in the upper part of the crown. After several years of attack, the tops may become completely bare and the trees take on more and more gray color.



Fig. 5. The budworm prefers the new foliage and when numerous may destroy the new shoots completely.



Fig. 6. After three or four years attack trees become seriously defoliated. After five or more years they die.

Nature of Outbreaks

Outbreaks follow several successive years of favorable weather combined with the right conditions in the forest. The danger of destructive outbreaks is greatest where there are large areas of forest containing a high percentage of balsam fir. The danger also increases with the age of the trees but the chief factors in encouraging attack are the area and density of the balsam-spruce forest. Once an outbreak gains momentum unfavorable weather will seldom end it, in fact the prevailing wind tends to spread the attack in its direction. Huge "flights" of moths may occur and in stormy weather these may be carried long distances; small caterpillars will also drift on silken threads. When an outbreak has developed, all types of balsam-spruce stands may become severely infested.

After an outbreak has destroyed most of the susceptible forest in a region, there is no further danger until the new forest grows up or the surviving younger stands mature. The new forest will always contain a high proportion of balsam and eventually becomes susceptible to a new outbreak. In New Brunswick, attacks have recurred at periods of 35 to 40 years.

Protection and Forest Management

The only way to prevent widespread damage in the present forest of northern New Brunswick is by spraying. The extent to which spraying will succeed in keeping the trees alive cannot be determined until the outbreak ends. Meanwhile it will help if cutting is concentrated in the heavily infested, susceptible areas where mature balsam predominates.

Spraying does not drive the moths out into other areas as some have thought. Rather it decreases the number of moths that disperse from a sprayed area.

Following the principles of forest management that appear below will reduce the future hazard of budworm attack:

- (1) Cut balsam fir as soon as it is mature.
- (2) Whenever possible, favor other species such as spruce and reduce the percentage of balsam fir.
- (3) Distribute cutting operations so that mature stands of balsam-spruce do not occur in large blocks but are scattered among stands of younger-aged or less susceptible trees.

Balsam fir is a valuable pulpwood tree and reproduces freely but is very susceptible to a number of insects and also to decay. Its management calls for short cutting cycles and a rotation age of 50 to 60 years. Following the above principles will reduce the danger of loss from other insects besides budworm.

Most farm woodlots lend themselves to this type of management because they are accessible. Usually they are less likely to be damaged severely because they occur in areas where cutting and clearing have reduced the extent of mature, highly susceptible stands. When outbreaks develop in the unbroken forest of the interior, woodlots may suffer severe defoliation; they may be reinfested repeatedly by drifting moths or larvae. This has happened in woodlots in the northern and eastern parts of the Province; in the south balsam fir occurs more frequently



Fig. 7. Spraying with DDT can prevent the killing of trees when properly done.



Fig. 8. Injury caused by the balsam woolly aphid; distinguished by swellings at the nodes and distortion of the twigs.

in mixture with other tree species. A mixture of trees in the woodlot reduces its susceptibility to severe, prolonged attack and also makes it more feasible to cut the balsam and favor the growth of spruce and other valuable trees.

The balsam woolly aphid complicates the problem in the south and along the eastern shore. Where this insect has damaged the trees, spraying for budworm is of doubtful value and not recommended. The spray will not control the aphid and it may kill predacious insects that help to keep down its numbers.

The damage caused by the balsam woolly aphid is sometimes attributed to the budworm. The two insects are not alike but the symptoms of attack may be confused; both kill balsam fir and produce a gray appearance of the trees and bare the tops. The aphid is a minute sucking insect that feeds on the bark and a swollen distorted condition of many of the twigs will indicate its presence. The above methods of management will reduce loss from both these insects. Anyone desiring further information about the balsam woolly aphid should obtain the Canada Department of Agriculture leaflet (Publication 977).

Estimating Hazard

After a stand has become severely infested by the budworm, the probable severity of the next year's attack can be estimated in late summer from the number of egg masses on the trees. This, combined with an estimate of the amount of defoliation and a consideration of the nature and location of the stand, will indicate when spraying or salvage is necessary. If you send samples of injured twigs to the Forest Biology laboratory with a description of the stand, we can help you to estimate the hazard.



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Christmas Trees

Although trees of the size used for Christmas trees are seldom killed unless overtopped by larger trees, their appearance may be spoiled by loss of needles in severely infested localities. Avoid using trees that are damaged by the budworm, or other insects such as the balsam gall midge or tussock moth. The amount of damage can be estimated in September. If damaged trees are left for a few years they will often recover their suitability for the Christmas tree trade.

The danger of this type of damage increases the nearer the trees are to stands of mature balsam fir. Protect valuable plantations or ornamentals by spraying thoroughly at the right time in early summer. Before you attempt to spray have the cause of the damage identified and obtain advice during the winter about the time and method of spraying.

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